Watch Out, Soft-Bodied Pests!

New weapons from the Agricultural Research Service could spell better control over silverleaf whiteflies and other soft-bodied insect pests, such as aphids.

When silverleaf whiteflies, *Bemisia argentifolii,* infest a plant, they look like tiny specks of ash covering leaves and stems. The pests suck sap from more than 600 kinds of plants including many fruit, vegetable, fiber, and ornamental crops. Their saliva can also transmit destructive plant viruses and disorders. Every year, whiteflies cause multimillion-dollar crop losses in the United States.

But ARS scientists are adding to the limited arsenal against this pest. They recently came up with a new way to apply insecticides that whiteflies can't readily escape. They also ranked wild species of tobacco plants for their commercial potential as sources of a natural insecticide known as sugar esters. And they devised lookalike synthetic versions of the natural compounds that were the forerunner of a commercial version soon to be a registered insecticide.

Conventional insecticide sprayers have had only limited success against this whitefly.

"That's because a high percentage of the adult and immature stages of *B. argentifolii* feeds and breeds on the lower surface of plant leaves," says ARS entomologist Alvin M. Simmons. "Most sprayers do not deliver insecticides effectively to the underside of plant leaves."

For this and other reasons—including insecticide cost and effectiveness and ecological, health, and aesthetic concerns—Simmons and his colleague, entomologist D. Michael Jackson, have been exploring alternative technologies to reduce the amounts of insecticide used and to better target them on fruits and vegetables.

All Fogged In

Under a cooperative research and development agreement with Strauch and Sons, Inc., of Bethesda, Maryland, the scientists tested and evaluated an ultrasonic fogging device.

Originally, the fogger was designed as a humidifier and fungicide applicator for produce in storage. The scientists wanted to see if it could effectively deliver low dosages of contact insecticides to whitefly-infested plants growing in a greenhouse.

Greenhouse whitefly control is crucial—not only because seedlings can be severely damaged, but also because this is where field outbreaks can get their start. Safe from winter and the weather, whiteflies can spend all year breeding and feeding on greenhouse plants. Then, when infested seedlings are transplanted outdoors, so are the whiteflies.

The scientists conducted fogger tests on whitefly-infested collard plants in greenhouses.

"The fogger dispenses about 4 gallons of water per hour, producing droplets of about 5 microns in diameter," Simmons says. "The droplets are so small, they act much like a gas."

The scientists showed that the fogger could successfully apply two whitefly-killing sprays in a mix with water that reached and coated the lower leaf surface.

One of the sprays used imidacloprid—one of the newest commercially available whitefly insecticides. The other spray was an experimental natural, or "biorational," insecticide consisting of sugar esters extracted from a species of wild tobacco plant known as *Nicotiana glutinosa.*

"Sugar esters break down the insects' outer coating, causing the pests to shrivel as they lose water," says Simmons. "The esters are relatively nontoxic to hard-bodied beneficial insect predators like lady beetles and to other beneficials."

With the fogger, similar amounts of the sprays coated both the top and bottom of infested leaves.

"In just 6 minutes, the fogger delivered less than half as much imidacloprid as the label recommended for control," Simmons says. But the result was a 100-percent whitefly kill.

ALVIN SIMMONS

A wild tobacco plant, *Nicotiana glutinosa,* is a source of sugar esters used as an experimental natural insecticide.

The scientists say the new fogger could work in commercial greenhouses as an automated method of controlling whiteflies.

"It would be ideal for controlling whiteflies and other target pests on high-value crops like poinsettias that have low damage thresholds and on greenhouse-grown vegetable crops for which low levels of contact insecticides are preferred," Simmons says.

Simmons and Jackson believe the fogger could also be adapted for field use, but the fog would need to be housed to protect it from the wind

until it could reach the plants. The fogger is available commercially from Shira Aeroponics, Ltd., of Rehovot, Israel.

While the fogger applies sugar esters in an effective manner, "current processing and production practices have been too expensive to make growing plants for their esters feasible commercially," says Jackson. "For the amounts of sugar esters that have been produced per acre, relative to the cost of extraction, it has been too expensive."

One problem has been not knowing which, of all the natural esters available from *Nicotiana,* would have the best commercial potential. To find out, Jackson and Simmons worked with other ARS scientists to grow and screen 21 wild *Nicotiana* species in field tests.

Cooperators included chemist Orestes T. Chortyk, who is retired from the former ARS Phytochemical Research Unit in Athens, Georgia; ARS agronomist Michael G. Stephenson at Tifton, Georgia; entomologist Chris D. Harlow and geneticist Vernon A. Sisson from the North Carolina State University in Oxford; and entomologist Albert W. Johnson at Clemson University in Florence, South Carolina.

"We selected eight candidate species, including *N. glutinosa,* for further study to determine which were the best sources of sugar esters," Jackson says.

In 1995, the scientists grew plants of all eight species in field plots at Florence and Charleston, South Carolina, and at Tifton. Three times during the season at each location, they cut the aboveground portion of the plants, weighed them, and extracted chemicals from the leaves.

"We believe the best commercial candidate overall is *N. trigonophylla.* Its esters are the least complex, very concentrated, and comparatively easy to extract," says Jackson.

Toward a Suitable Synthetic

At another ARS laboratory, in Kearneysville, West Virginia, ARS entomologist Gary Puterka focuses on a different soft-bodied insect pest—the pear psylla, *Cacopsylla pyricola*. This yellowish-green insect may be the primary reason the East Coast pear industry has disappeared.

Sugar esters have been among the most successful biorational compounds Puterka has used against these pests in tests at ARS' Appalachian Fruit Research Station. When he sprayed esters mixed with water on pear leaves, the compounds killed both nymphs and adults.

Searching for an easier and cheaper way to mass-produce the esters, Puterka worked with Ava Chemical Ventures of Portsmouth, New Hampshire. Recently, the firm produced a lookalike synthetic version of the active ingredient in natural sugar esters.

Working with Ava Chemical, he identified a form of synthetic sugar ester that is readily water soluble, yet remains active in controlling insects. Says Puterka, "The major problem with earlier versions of synthetic sugar esters was their inability to dissolve in water."

Puterka is conducting further studies under a cooperative research and development agreement with the New Hampshire company. He believes the synthetic esters will soon be fully registered and could be commercially available in the United States by 1999.—By **Hank Becker,** ARS.

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